
**Colorado State University's**
**Information Science and Technology Center (ISTeC)**
***presents <u>two</u> lectures by***

# Dr. David Ruppert

Andrew Schultz Professor of Engineering
School of Operations Research and Information Engineering and Department of Statistical Science
Cornell University

## ISTeC Distinguished Lecture
## in conjunction with the
## Electrical and Computer Engineering Department and Computer Science Department Seminar Series

# "Cosmic Rays and Bayesian Computations"

**Monday, December 5, 2011**
Reception: 10:30 a.m.
Lecture: 11:00 – 12:00 noon
Location: Lory Student Center, Room 230

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## Statistics Department Seminar

***sponsored by ISTeC and the Statistics Department***

# "Functional Generalized Additive Models"

**Monday, December 5, 2011**
Reception: 3:30 p.m., Statistics Building, Room 213
Lecture: 4:00 p.m. – 5:00 p.m.
Location: Weber Building, Room 223

# ABSTRACTS

**"Cosmic Rays and Bayesian Computations"**

Cosmic rays are atomic nuclei moving with velocities close to that of light. Of particular interest to astronomers are Ultra High Energy Cosmic Rays (UHECRs). Each UHECR is approximately ten million times more energetic than the most energetic particles produced at the Large Hadron Collider. The sources of UHECRs and the mechanisms by which they are accelerated to such high energies are unknown but of great interest. Active galactic nuclei (AGNs) have been hypothesized as a source of UHECRs. An AGN is a galaxy center where matter accretes into a super massive black hole. We use Bayesian analyze to investigate the evidence that UHECRs originate in AGN. Bayesian analysis has a different philosophical base than traditional "frequentist" statistics. Until recently, Bayesian analysis was little used, partly for philosophical reasons, but also because Bayesian computations were intractable in all but the simplest cases. This has changed with the development of fast and inexpensive computers and effective Bayesian computational methods.

**"Functional Generalized Additive Models"**

We introduce the functional generalized additive model (FGAM), a novel regression model for association studies between a scalar response and a functional predictor. We model the link-transformed mean response as the integral with respect to $t$ of $F\{X(t),t\}$; where $F(\cdot,\cdot)$ is an unknown regression function and $X(t)$ is a functional covariate. Rather than having an additive model in a finite number of principal components as in Muller and Yao (2008), our model incorporates the functional predictor directly and we regard our model as the natural functional extension of generalized additive models. We estimate $F(\cdot,\cdot)$ using tensor-product B-splines with roughness penalties. A pointwise quantile transformation of the functional predictor is also considered to ensure each tensor-product B-spline has observed data on its support. We evaluate the model using simulated data and compare its predictive performance with some other popular scalar-on-function regression models. We illustrate the usefulness of our approach through an application to brain tractography, where $X(t)$ is taken to be a signal from diffusion tensor imaging at position, $t$, along a tract in the brain. In one example, the response is disease-status (case or control) and in a second example, it is score on a cognitive test.

**SPEAKER BIOGRAPHY**

David Ruppert (http://legacy.orie.cornell.edu/~davidr/index.html) is the Andrew Schulz Jr. Professor of Engineering, School of Operations Research and Information Engineering, and Professor of Statistical Science, Cornell University. He received a BA in Mathematics from Cornell University in 1970, an MA in Mathematics from the University of Vermont in 1973, and a PhD in Statistics and Probability from Michigan State University in 1977. He was Assistant and then Associate Professor of Statistics at the University of North Carolina, Chapel Hill, from 1977 to 1987. He has been at Cornell since 1987. He is a Fellow of the American Statistical Association (ASA) and the Institute of Mathematical Statistics (IMS) and received the Wilcoxon Prize in 1986. He has had 25 PhD students, many of them now leading researchers. He has been named "Highly cited" researcher by ISIHighlyCited.com. He is a former editor of the *IMS Lecture Notes—Monographs Series* and former associate editor of *American Statistician, Annals of Statistics, Biometrics*, and *JASA*. He is currently editor of the *Electronic Journal of Statistics*.

Professor Ruppert has worked on stochastic approximation, transformations and weighting in regression, and smoothing. His recent research has focused on Bayesian statistics, measurement error models, splines, semiparametric regression, environmental statistics, functional data analysis, and statistics in astronomy. He has published over 100 articles in refereed journals and has published five books, *Transformation and Weighting in Regression*, *Measurement Error in Nonlinear Models* (first and second editions), *Semiparametric Regression*, *Statistics and Finance: An Introduction*, and *Statistical Modeling and Data Analysis for Financial Engineering*

**To arrange a meeting with the speaker**, please contact Prof. Haonan Wang at wanghn@stat.colostate.edu or (970)491-2449.

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